Bul. 648

Pesticide Use on Field Grown Fresh Market Vegetable Crops in Ohio 1977

OSU Cooperative Extension Service
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5/79—2.5M

Issued in furtherance of Cooperative Extension Work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Roy M. Kottman, Director of the Cooperative Extension Service, The Ohio State University.

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Pesticide use surveys as such have not been conducted, to the author's knowledge, in Ohio in past years on agricultural crops, for homeowners or for institutional uses. Formerly the answers to inquiries on pesticide use were the estimates of Extension Service Specialists related to their knowledge of agricultural practices and recommendations for pesticide use. These estimates were satisfactory until several agencies began quoting such as actual fact. Consequently, Extension Specialists no longer would volunteer the estimates.

With the advent of EPA's benefit/risk analysis of evaluating all pesticides in the registration and reregistration process and, in particular, with the RPAR program (Rebuttable Presumption Against Registration), it became evident that use data was essential, if we were to provide adequate benefits-use data and defend the pesticide uses that are essential to Ohio agricultural production. Thus, this report is the first of several to indicate the use of pesticides in Ohio agriculture as determined by various surveys of the growers. It was conducted as a part of the Ohio State University program for Pesticide Impact Assessment.

Listings of vegetable growers in Ohio were obtained from the State Crop Reporting Service and reviewed with the Ohio Vegetable and Potato Growers Association. The sample for the survey was taken from those growers involved in field vegetable production generally for the fresh market. Although some data were collected and reported herein on vegetables also categorized as processing crops (tomatoes, potatoes, cucumbers and sweet corn), these latter four crops, however, will be included in a national and state pesticide use survey to be conducted in 1979. Thus, no major efforts were made to include such growers in the sample for the survey reported herein, but sampling was sufficient to establish data for potatoes and sweet corn.

Because of the limited number of fresh market vegetable growers in Ohio, excluding those for the four crops mentioned in the last paragraph, as many as possible of the total were contacted during the spring and early summer of 1978. Personal contact was made with growers in Celeryville, Hartville, Toledo and Columbus. A questionnaire was mailed to those not available for personal contact. Because of difficulties in arranging for personal contacts in the southwestern part of Ohio (Cincinnati, Harrison, etc.), questionnaires were mailed with telephone calls before and after as an introduction and a follow-up. Data were not obtained from the southeastern part of the state due to no inclusions on the grower lists from which we worked. (Later information indicated some growers in that area.) The summation of growers and contacts for this survey is listed in Table 1. A summary of the farm operations contacted in the survey indicating the acreage range of production for each vegetable crop is tabulated in Table 2. Twenty-four of the 31 growers responded to the survey.

Table 3 includes data on the acreage of particular fresh market vegetable crops grown in Ohio and the number of acres that were reported in the survey. Total acreages per crop were determined from the statistics of the Ohio Crop Reporting Service and the knowledge of Cooperative Extension Service Specialists. The other information in Table 3 estimates the percentage and calculated acreage of the particular crop commodity that was treated with pesticides for weed, insect and disease control. In some cases even though the number of acres of the crop included in the survey results is of low percentage of the total state crop acreage, Extension Specialists indicated that the response was typical for that crop in the state. Consequently, state totals were extrapolated. Crops for which data are not included, because of the very limited survey information, are: Broccoli, Cauliflower, Cucumbers, Rhubarb and Tomatoes. The reports on pesticide use for carrots and melons also represent only a very low percentage of the acreage, but expert opinion indicates that the responses were typical for the crops and successful crop production requires such uses of pest control chemicals.

Results of the survey indicate that herbicides were applied to about 92 percent, insecticides to about 97 percent and fungicides to about 63 percent of the commercial fresh market vegetable crop acreage in Ohio. The percentage of acres treated with pesticides varies for each individual crop commodity, as shown in Table 4. Pesticide usage on backyard garden and noncommercial vegetable crop acreages are not included in this survey.

Table 4 provides data on the various individual pesticides that were applied to each crop in 1977. It includes the acreage of the crops treated, the percent of the total acreage treated and the quantity in active ingredient of each pesticide used on that crop in the state.

Pesticide trade names and common names are used that best identify products without any intent of discrimination or promotion of the product.

Table 5, in turn, summarizes the data for each pesticide used, indicating the quantity of active ingredient used on each crop and the total amount utilized in the state on fresh market vegetables. Also included is the total amount of active ingredient insecticide, herbicide and fungicide used on each crop reported in the survey. The total quantity of insecticides used on all Ohio fresh market vegetable crops reported in this survey in 1977 and listed in Table 5 was 255,132 pounds with Sevin (Carbaryl), accounting for 41.0 percent of the total; Chlordane, 9.2; Di-Syston, 7.0; Parathion, 6.3, Malathion, 5.9; Temik, 5.6; Lannate 4.5; Diazinon, 3.9; Furadan, 3.6; and Thiodan, 3.4 percent. The remainder of the insecticides listed accounted for 9.4 percent of the total quantity used. A total of 144,951 pounds of herbicides were used, plus 3,426 gallons of Stoddard Solvent used on parsley, and 4,112 gallons or 32,174 pounds of MH-30 sprout inhibition for potatoes. Of the total pounds of herbicides used, Eptam accounted for 26.0; Lasso, 14.1; Dinoseb, 11.3; TOK, 10.2; Bladex, 5.4; Vegedex, 5.0; Randox, 4.6; CIPC, 4.5; and Amiben, 4.3 percent with the remainder listed accounting for 14.6 percent of the total. A total of 221,030 pounds of fungicides were used in 1977 with Mancozeb accounting for 60.2 percent of the total; Copper, 13.7; Polyram, 12.9; Bravo, 7.3; and the remaining fungicides 5.9 percent.

Data related to the personnel involved in applying pesticides to vegetable crops and the method of application are recorded in Tables 6 and 7. Table 6 presents the data related only to the pesticide application; whereas Table 7 shows the correlation of application procedures for each pesticide in relation to the specific crop. It is noted that the majority of pesticide applications were made by the farm owner or operator with ground equipment and that commercial applicators were involved only in aerial application. Also the survey showed that most pesticides on vegetable crops were broadcast applied.

The use of protective clothing and equipment by vegetable growers applying pesticides is shown in Table 8, as related to the specific pesticide. As noted, the number of applicators for each pesticide is limited, but the response to the questionnaire does show some relationship to concern for personal protection. It should be noted that in some cases perhaps more protective clothing and equipment than that specified on the pesticide label was used by some applicators. However, the data showed a definite lack of concern in personal protection when using the highly toxic pesticide formulations such as Di-Syston, Dyfonate, Lannate, Monitor, Parathion, Temik, etc. This infers that the applicator is either not reading the pesticide label or is disregarding the precautionary instructions.

Pesticide storage facilities and procedures used by fresh market vegetable growers are shown in Table 9. Results of the survey indicate that the provisions for pesticide storage on the majority of vegetable farm operations are not adequate, according to good safety standards. About 62 percent of the growers store pesticides in buildings housing other materials, although about half of such facilities are equipped with barriers to separate pesticide storage from other materials. Approximately 52 percent of the growers have separate storage facilities, but as the data indicate, some may store quantities of pesticides in separate facilities and yet use secondary storage that is not separate from other materials when the pesticide is being used. It should also be noted that only about ⅓ of the growers keep the storage area locked and accessible only to authorized personnel. The quality of storage areas is also sub-standard for most operations, as shown by the data. However, on the plus side, if this data is correct, 100 percent of the growers reported that they kept the pesticides in their original containers.

Vegetable growers reported that they normally purchased only the estimated quantity of pesticides needed for the growing season and thus avoided the problems of surplus pesticide disposal. Table 10 shows that when surplus pesticides did remain at the end of the season, where possibly they were stored for use the next year or in some cases returned to the dealer. Only 4.8 percent of the growers used the pesticide for some other labeled use, disposed of the surplus by diluting and spraying over an isolated area or disposed of surplus in landfills. None of the survey reports indicated that the grower disposed of surplus pesticides by burying, incinerating or used the facilities of a commercial waste disposal company. Of significant importance is the indication that none of the growers who responded to the questionnaire disposed of surplus pesticides in such a manner as to contaminate sewer systems, waterways or environmental factors.

Most of the empty pesticide containers were disposed of by satisfactory procedures, as indicated in Table 11. The major exceptions are that about 10 percent of the vegetable growers used some containers for other purposes and also dumped containers in out-of-the-way places. No attempt was made to determine the significance of such dumping to a littering and contamination problem.

Table 12 shows that vegetable growers used the Cooperative Extension Service, their personal experience and the recommendations from dealers in order of preference for obtaining information and recommendations for pest control. The compatibility with existing equipment was the most prevalent economic factor in selection of pesticides, although the cost factors ranked a very close second. In choosing between two pesticides of relative equal control potential, most growers indicated they would select that one with the lower toxicity. Forty-five percent of the growers indicated that the choice could be affected by the personal exposure involved, by satisfactory pest control without too much consideration of toxicity and a short day-to-day harvest interval.

The consensus was that the program for certification of applicators had little deterrent to the selection of the pesticide with the conclusion that growers did not overly object to the current requirements for pesticide applicator training and certification either as a commercial or private applicator.

Table 1: Vegetable Growers Involved in Survey

Area	Number of Growers	Personal Contacts	Questionnaires Mailed	Questionnaires Returned	Information Via Tel.
Celeryville	5	4	1	0	0
Hartville	5	2	3	1	0
Toledo	3	3	0	0	0
Columbus	7	4	2	1	1
Cincinnati	5	0	5	3	0
Harrison	4	0	4	2	0
Huron	1	0	1	1	0
Cedarville	1	0	1	1	0
Total	31	13	18	9	1

Table 2: Characteristics of Farm Operation in the Survey

Crop	Number of Farms of Acreage Range									Total farms in survey producing commodity (from 24 responses)
	Acreage Range of Crop Production									
	1	1-5	5-10	10-25	25-50	50-100	100-200	200-400	>400	
Asparagus	0	0	1	0	0	0	0	0	0	1
Beans (Green)	1	3	0	0	0	1	0	0	0	5
Beets	0	1	1	1	0	0	0	0	0	3
Broccoli	1	0	0	0	0	0	0	0	0	1
Cabbage	2	2	1	0	2	0	1	1	0	9
Carrots	0	1	0	0	1	0	0	0	0	2
Cauliflower	1	0	0	0	0	0	0	0	0	1
Celery	0	0	0	0	0	2	0	0	0	2
Cucumber	1	0	0	0	0	0	0	0	0	1
Egg Plant	1	0	1	0	0	0	0	0	0	2
Lettuce	0	2	1	1	0	1	3	0	0	8
Melons	1	4	2	0	0	0	0	0	0	7
Onions	2	0	0	2	1	3	0	1	0	9
Parsley	1	0	2	1	1	0	0	0	0	5
Peppers	2	2	0	0	1	0	0	0	0	5
Potatoes	0	4	0	0	0	1	1	3	0	9
Pumpkin	0	5	1	0	1	0	0	0	0	7
Radishes	0	0	0	1	1	1	1	0	1	5
Rhubarb	1	0	0	0	0	0	0	0	0	1
Spinach	0	1	1	2	0	0	0	0	0	4
Squash	1	2	0	0	1	0	0	0	0	4
Sweet Corn	0	1	2	1	3	2	2	1	1	13
Tomatoes	2	3	0	0	0	0	0	0	0	5
Turnips	0	0	1	0	1	0	0	0	0	2

Table 3: Ohio Fresh Market Vegetable Crop Pesticide Usage—1977

Crop	Acreage		Acreage Treated for Control of					
	Total	Surveyed	Weeds		Insects		Disease	
			%	Acres	%	Acres	%	Acres
Asparagus	200	10.0	100.0	200	0.0	0	0.0	0
Beans (Green)	1700	76.5	92.8	1578	100.0	1700	5.9	100
Beets	50	32.0	78.1	39	84.4	42	62.5	31
Broccoli	25	0.3*						
Cabbage	2200	510.4	98.0	2156	100.0	2200	67.0	1474
Carrots	1100	32.5	100.0	1100	93.8	1031	93.8	1031
Cauliflower	500	0.3*						
Celery	230	140.0	100.0	230	100.0	230	100.0	230
Cucumber	7000	0.5*						
Egg Plant	200	8.5	100.0	200	100.0	200	0.0	0
Lettuce	1350	616.5	100.0	1350	99.8	1347	1.1	15
Melons	1900	24.8	47.6	904	98.8	1877	94.8	1801
Onions	800	655.7	100.0	800	100.0	800	93.8	750
Parsley	67**	67.0	100.0	67	60.2	40	70.7	47
Peppers	1200	54.0	97.2	1166	98.1	1177	93.5	1122
Potatoes	13200	1216.0	99.8	12970	100.0	13200	99.5	12930
Pumpkin	1250	49.5	90.9	1136	98.0	1225	70.7	884
Radishes	1200	776.0	0	0	76.7	920	15.5	186
Rhubarb	—	0.2*						
Spinach	200	47.0	100.0	200	31.9	64	63.8	128
Squash	400	44.0	92.0	368	100.0	400	100.0	400
Sweet Corn	14500	1410.0	99.4	14413	98.5	14282	36.0	5220
Tomatoes	900	5.25*						
Turnips	410	10.0	20.0	82	20.0	82	20.0	82
Totals	42157	5779.9	92.4	38959	96.8	40817	62.7	26431

*Acreage not of sufficient sample to permit significant determination of pesticides use on commodity in the state and not included in the totals.
**Total acreage of parsley is not known; thus surveyed acreage is used for calculation.

Table 4: Pesticide Use on Commercial Fresh Market Vegetable Crops in Ohio — 1977

Crop (Acreage)	Pesticide	Crop Acreage Treated	% Treated	Quantity of Pesticide Used (lb.)
Asparagus (200)	**Herbicides**			
	Princep	200.0	100.0	860.0
Green Beans (1700)	**Insecticides**			
	Diazinon	22.2	1.3	44.4
	Di-Syston	1587.3	93.5	2335.4
	Lannate	77.7	4.6	17.8
	Sevin	88.8	5.2	94.4
	Herbicides			
	Treflan	1554.0	91.5	1165.5
	Vegedex	22.2	1.3	66.6
	Fungicides			
	Zineb	99.9	5.9	299.7
Table Beets (50)	**Insecticides**			
	Dylox	10.9	21.9	54.6
	Ethion	7.8	15.6	29.2
	Malathion	31.2	62.5	156.0
	Parathion	31.2	62.5	65.5
	Sevin	31.2	62.5	124.8
	Herbicides			
	Pyramin	31.2	62.5	124.8
	Vegedex	7.8	15.6	31.2
	Fungicides			
	Zineb	31.2	62.5	210.6
Cabbage (2200)	**Insecticides**			
	Dipel	1.3	0.1	159.1
	Chlordane	150.8	6.9	1206.8
	Diazinon	1293.1	58.8	87.1
	Guthion	323.2	14.7	673.2
	Lannate	538.8	24.5	969.8
	Malathion	8.6	0.4	4.3
	Metasystox-R	538.8	24.5	538.8
	Monitor	1293.1	58.8	1034.4
	Parathion	1323.2	60.2	655.1
	Sevin	10.3	0.5	49.6
	Thiodan	4.3	0.2	2.2
	Herbicides			
	Dacthal	19.5	0.9	155.2
	TOK (Nitrofen)	538.8	24.5	2155.0
	Treflan	1876.1	85.3	1337.0
	Fungicides			
	Chlorothalonil	0.4	0.02	0.9
	Copper	1293.1	58.8	2897.6
	Dithane M-45	1293.1	58.8	3103.2
Carrots (1100)	**Insecticides**			
	Diazinon	1014.0	92.3	2028.0
	Malathion	1014.0	92.3	6337.5
	Herbicides			
	Lorox	1100.0	100.0	1647.8
	TOK	1014.0	92.3	6084.0
	Fungicides			
	Maneb	1014.0	92.3	2028.0
Celery (230)	**Insecticides**			
	Dipel	230.0	100.0	560.0
	Malathion	230.0	100.0	2240.0
	Phosdrin	230.0	100.0	896.0
	Herbicides			
	TOK	230.0	100.0	896.0
	Vegedex	230.0	100.0	672.0
	Fungicides			
	Copper	230.0	100.0	725.8
	Dyrene	230.0	100.0	1344.0
	Mancozeb	230.0	100.0	2150.4
Eggplant (200)	**Insecticides**			
	Metasystox-R	188.0	94.1	188.0
	Sevin	12.0	5.9	82.0
	Herbicides			
	Amiben	188.0	94.1	564.0
	Treflan	12.0	5.9	9.4
Lettuce (1350)	**Insecticides**			
	Cygon	326.2	24.2	170.8
	Dipel	4.4	0.3	2.2
	Diazinon	1342.5	99.4	2152.7
	Di-Syston	394.5	29.2	768.7
	Malathion	394.2	29.2	492.8
	Parathion	394.2	29.2	197.1
	Phosdrin	974.6	72.2	1461.8
	Sevin	939.5	69.6	6427.6
	Thiodan	367.9	27.2	145.4
	Herbicides			
	CIPC	613.2	45.4	2452.8
	Vegedex	1350.0	100.0	5724.7
	Fungicides			
	Zineb	15.3	1.1	34.5
Melons (1900)	**Insecticides**			
	Dibrom	459.6	24.2	3217.2
	Guthion	612.8	32.2	919.2
	Malathion	612.8	32.2	1838.4
	Parathion	229.8	12.1	153.2
	Sevin	76.6	4.0	536.2
	Herbicides			
	Amiben	383.0	20.2	1532.0
	Dacthal	268.1	14.1	1398.0
	Treflan	25.3	1.3	19.2
	Fungicides			
	Benlate	191.5	10.1	145.5
	Bravo	1263.9	66.5	14649.8
	Captan	612.8	32.2	1378.8
	Copper	612.8	32.2	17618.0
	Dinocap	306.4	16.1	15.3
	Mancozeb	536.2	26.4	2022.2
	Ziram	306.4	16.1	467.3
Onions (800)	**Insecticides**			
	Diazinon	677.4	84.7	3807.5
	Di-Syston	0.6	0.1	0.6
	Dyfonate	640.5	80.1	640.5
	Ethion	201.3	25.2	878.4
	Guthion	640.5	80.1	1842.2
	Parathion	48.8	6.1	219.6
	Herbicides			
	CIPC	689.9	86.2	3662.4
	Dacthal	0.3	0.04	1.8
	Lasso	48.8	6.1	390.4
	Randox	585.6	73.2	6636.8
	TOK	689.9	86.2	5435.1
	Vegedex	12.2	1.5	48.8
	Fungicides			
	Bravo	48.8	6.1	175.7
	Captan	79.3	9.9	317.2
	Dyrene	640.5	80.1	1912.5
	Mancozeb	640.5	84.4	3075.6
	Zineb	12.2	1.5	56.1
Parsley (67)	**Insecticides**			
	Malathion	40.0	60.2	200.0
	Parathion	40.0	60.2	105.0
	Herbicides			
	Stoddard Solvent	59.0	88.7	3426.0 gal
	TOK	67.0	100.0	158.0
	Fungicides			
	Mancozeb	47.0	70.7	225.6

Table 4: Pesticide Use on Commercial Fresh Market Vegetable Crops in Ohio — 1977 . . . continued

Crop (Acreage)	Pesticide	Crop Acreage Treated	% Treated	Quantity of Pesticide Used (lb.)
Peppers (1200)	**Insecticides**			
	Lannate	1122.1	93.5	2009.8
	Metasystox-R	1111.0	92.6	1111.0
	Sevin	66.7	5.6	133.3
	Thiodan	55.6	4.6	26.7
	Furadan	1111.0	92.6	5555.0
	Herbicides			
	Enide	1111.0	92.6	3333.0
	Treflan	1166.6	97.2	886.6
	Fungicides			
	Copper	1111.0	92.6	177.8
	Zineb	11.1	0.9	33.3
	Ziram	11.1	0.9	16.7
Potatoes (13200)	**Insecticides**			
	Chlordane	3696.0	28.0	22176.0
	Di-Syston	4330.0	32.8	13811.5
	Furadan	13.2	0.1	39.6
	Guthion	13.2	0.1	9.9
	Lannate	6943.0	52.6	3348.9
	Malathion	13.2	0.1	26.4
	Monitor	4554,9	34.5	5963.6
	Parathion	11458.0	86.8	8408.3
	Sevin	10507.0	79.6	12814.6
	Temik	4726.0	35.8	14226.9
	Thiodan	3722.0	28.2	8301.3
	Herbicides			
	Dinoseb	7973.0	60.4	16488.4
	Eptam	7986.0	60.5	37673.1
	Lasso	4567.0	34.6	37673.1
	Lorox	6785.0	51.4	3278.5
	Sencor	8197.0	62.1	2328.8
	Treflan	26.4	0.2	19.4
	MH-30			4112.0 gal.
	Fungicides			
	Bravo	13.2	0.1	19.8
	Copper	4303.0	32.6	7305.3
	Captan	13.2	0.1	9.9
	Dithane M-45	6772.0	51.3	122312.0
	Difolatan	1030.0	7.8	3090.0
	Polyram	4726.0	35.8	28595.0
Pumpkins (1250)	**Insecticides**			
	Guthion	50.4	4.0	75.6
	Lannate	756.0	60.6	1360.8
	Malathion	50.4	4.0	151.2
	Metasystox-R	756.0	60.6	756.0
	Sevin	466.2	37.4	1025.6
	Herbicides			
	Amiben	1134.0	90.9	3049.2
	Fungicides			
	Benlate	756.0	60.6	567.0
	Bravo	126.0	10.1	1134.0
	Captan	50.4	4.0	113.4
	Copper	50.4	4.0	1451.5
Radishes (1200)	**Insecticides**			
	Diazinon	728.5	60.6	1776.6
	Dyfonate	155.0	12.9	310.0
	Malathion	697.5	58.0	3487.5
	Parathion	744.0	61.9	1562.4
	Fungicides			
	Zineb	186.0	15.5	436.3
Spinach (200)	**Insecticides**			
	Guthion	63.8	31.9	63.8
	Parathion	63.8	31.9	63.8
	Thiodan	63.8	31.9	95.6
	Herbicides			
	CIPC	106.2	53.2	382.5
	Vegedex	98.5	46.8	374.0
	Fungicides			
	Zineb	85.0	42.6	127.5
Squash (400)	**Insecticides**			
	Diazinon	4.6	1.1	6.8
	Guthion	4.6	1.1	6.8
	Lannate	364.0	90.9	163.8
	Malathion	4.6	1.1	9.1
	Metasystox-R	364.0	90.9	182.0
	Parathion	13.6	3.4	9.1
	Thiodan	4.6	1.1	6.8
	Sevin	36.4	9.1	159.2
	Herbicides			
	Amiben	368.6	92.0	1103.4
	TOK	4.6	1.1	9.1
	Fungicides			
	Benlate	368.6	92.0	94.6
	Bravo	4.6	1.1	75.1
	Captan	4.6	1.1	10.0
	Copper	4.6	1.1	120.0
	Mancozeb	31.8	8.0	91.0
Sweet Corn (14500)	**Insecticides**			
	Counter	1387.8	9.6	914.9
	Di-Syston	1028.0	7.1	1028.0
	Lannate	2600.8	17.9	3691.5
	Metasystox-R	5140.0	35.5	1028.0
	Parathion	2827.0	19.5	5162.6
	Sevin	6774.5	46.7	83150.8
	Furadan	5140.0	35.5	3598.0
	Herbicides			
	Aatrex	6610.0	45.6	1408.4
	Bladex	8275.4	57.1	7802.5
	2,4-D	1028.0	7.1	514.0
	Lasso	7925.9	54.7	16406.9
	Sutan	5140.0	35.5	2755.0
Turnips (410)	**Insecticides**			
	Diazinon	82.0	20.0	82.0
	Malathion	82.0	20.0	205.0
	Parathion	82.0	20.0	59.4
	Sevin	82.0	20.0	164.0
	Herbicides			
	Vegedex	82.0	20.0	328.0
	Fungicides			
	Zineb	82.0	20.0	393.6

Table 5-1: Quantity of Pesticides Used on Vegetable Crops in Ohio (lbs)

PESTICIDE A Insecticide	Asparagus	Beans (green)	Beets	Cabbage	Carrots	Celery	Eggplant	Lettuce	Melons	Onions	Parsley	Peppers	Potatoes	Pumpkin	Radishes	Spinach	Squash	Sweet Corn	Turnips	TOTAL
Chlordane				1207									22176							23383
Counter																		915		915
Cygon								171												171
Diazinon		44		87	2028			2153		3808					1777		7		82	9986
Dibrom									3217											3217
Dipel				159		560		2												721
Di-System		2335						769		1			13812					1028		17945
Dyfonate										640					310					950
Dylox			55																	55
Ethion			29							878										907
Furadan												5555	40					3598		9193
Guthion				673					919	1842			10	76		64	7			3591
Lannate		18		970								2010	3349	1361			164	3692		11564
Malathion			156	4	6338	2240		493	1838		200		26	151	3488		9		205	15148
Metasystox-R				539			188					1111		756			182	1028		3804
Monitor				1034									5964							6998
Parathion			66	655				197	153	219	105		8408		1562	64	9	5163	59	16660
Phosdrin						896		1462												2358
Sevin		94	124	50			82	6428	536			133	12815	1026			159	83151	164	104762
Temik													14227							14227
Thiodan				2				145				26	8301			96	7			8577
Totals		2491	430	5380	8366	3696	270	11820	6663	7388	305	8835	89128	3370	7137	224	544	98575	510	255132

Table 5-2: Quantity of Pesticides Used on Vegetables in Ohio (lbs)

PESTICIDES B Herbicide	Asparagus	Beans (green)	Beets	Cabbage	Carrots	Celery	Eggplant	Lettuce	Melons	Onions	Parsley	Peppers	Potatoes	Pumpkin	Radishes	Spinach	Squash	Sweet Corn	Turnips	TOTAL
Aatrex																		1408		1408
Amiben							564		1532					3049			1103			6248
Bladex																		7802		7802
CIPC								2453		3662						382				6497
2,4-D																		514		514
Dacthal				155					1398	2										1555
Dinoseb													16448							16448
Enide												3333								3333
Eptam													37673							37673
Lasso										390			3623					16407		20420
Lorox					1648								3279							4927
MH-30													4112 gal							4112 gal
Princep	860																			860
Pyramin			125																	125
Randox										6637										6637
Sencor													2329							2329
Stoddard											3426 gal									3426 gal
Sutan																		2755		2755
TOK				2155	6084	896				5435	158						9			14737
Treflan		1166		1337			9		19			887	19							3437
Vegedex		67	31			672		5725		49						374			328	7246
Totals	860	1233	156	3647	7732	1568	573	8178	2949	16175	158	4220	63371	3049		756	1112	28886	328	144951

Table 5-3: Quantity of Pesticides Used on Vegetable Crops in Ohio (lbs)

PESTICIDE C Fungicide	Asparagus	Beans (green)	Beets	Cabbage	Carrots	Celery	Eggplant	Lettuce	Melons	Onions	Parsley	Peppers	Potatoes	Pumpkin	Radishes	Spinach	Squash	Sweet Corn	Turnips	TOTAL
Benlate									146					567			95			808
Bravo				1					14650	175			20	1134			75			16055
Captan									1379	317			10	113			10			1829
Copper				2898		726			17618			178	7305	1452			120			30297
Difolatan													3090							3090
Dinocap									15											15
Dyrene						1344				1913										3257
Mancozeb				3103		2150			2022	3076	226		122312				91			132980
Maneb					2028															2028
Polyram													28595							28595
Zineb		300	210					35		56		33			436	128			394	1592
Ziram									467			17								484
Totals		300	210	6002	2028	4220		35	36297	5537	226	228	161332	3266	436	128	391		394	221030

Table 6-1: Application of Pesticides Related to Identity of the Applicator and Method of Application

PESTICIDE	Percent of Pesticide Applied				Method of Application	
	Self		Commercial Applicator		Band	Broadcast
A. Insecticide	Ground	Aerial	Ground	Aerial	(%)	(%)
Chlordane	100					100
Counter	100				100	
Cygon	50			50		100
Diazinon	82			18		100
Dibrom	50			50		100
Dipel	83			17		100
Di-Syston	96			4	40	60
Dyfonate	100				67	33
Dylox	100					100
Ethion	75			25	50	50
Furadan	61			39	60	40
Guthion	37			63		100
Lannate	71			29		100
Malathion	56			44		100
Metasystox-R	73			27		100
Monitor	100					100
Parathion	33			67		100
Phosdrin	62			38		100
Rotenone	100					100
Sevin	38			62	7	93
Temik	100					100
Thiodan	2			98		100

Table 6-2: Application of Pesticides Related to Identity of the Applicator and Method of Application

PESTICIDE	Percent of Pesticide Applied				Method of Application	
	Self		Commercial Applicator		Band	Broadcast
B. Herbicide	Ground	Aerial	Ground	Aerial	(%)	(%)
Aatrex	94			6		100
Amiben	100					100
Bladex	44			56		100
CIPC	100					100
2,4-D	100					100
Dacthal	100					100
Dinoseb	50			50		100
Enide	100					100
Eptam	100					100
Lasso	100				20	80
Lorox	100					100
Paraquat	100					100
Princep	100				50	50
Pyramin	100					100
Ramrod	100					100
Randox	100					100
Sencor	100					100
Stoddard Solvent	100					100
Sutan				100		100
TOK	100					100
Treflan	100					100
Vegedex	100					100

Table 6-3: Application of Pesticides Related to Identity of the Applicator and Method of Application

PESTICIDE	Percent of Pesticide Applied				Method of Application	
	Self		Commercial Applicator		Band	Broadcast
C. Fungicide	Ground	Aerial	Ground	Aerial	(%)	(%)
Benlate	67			33		100
Bravo	71			29		100
Captan	33			67		100
Copper	74			26		100
Difolatan	100					100
Dyrene	53			47		100
Karathane	100					100
Maneb	50			50		100
Mancozeb	58			42		100
Polyram	100					100
Zineb	38			62		100
Ziram	100					100

Table 7-1: Pesticide Application to Vegetable Crops as Related to Pesticide Applicator and Method of Application

PESTICIDE		Percent of Pesticide Applied				Method of Application	
		Self		Commercial Applicator		Band	Broadcast
A. Insecticide	Crop	Ground	Aerial	Ground	Aerial	(%)	(%)
Chlordane	Cabbage	100					100
	Potatoes	100					100
Counter	Sweet Corn	100				100	
Cygon	Lettuce	50			50		100
Diazinon	Beans (Green)	100					100
	Cabbage	100					100
	Carrots	100					100
	Lettuce	100					100
	Onions	100					100
	Radishes	2			98		100
	Squash	100					100
	Turnips				100		100
Dibrom	Melons	50			50		100
Dipel	Cabbage	100					100
	Celery				100		100
	Lettuce	100					100
Di-Syston	Beans (Green)	100					100
	Lettuce				100		100
	Onions	100					100
	Potatoes	100					100
	Sweet Corn	100					100
Dyfonate	Onions	100				100	
	Radishes	100					100
Dylox	Beets	100					100
Ethion	Beets	100					100
	Onions	100					100
Furadan	Peppers	100				100	
	Potatoes	100					100
	Sweet Corn				100		100
Guthion	Cabbage	36			64		100
	Melons	100					100
	Onions				100		100
	Potatoes	100					100
	Pumpkin	100					100
	Spinach	100					100
	Squash	100					100
Lannate	Beans (Green)	100					100
	Cabbage	100					100
	Peppers	100					100
	Potatoes	1			99		100
	Pumpkin	100					100
	Squash	100					100
	Sweet Corn	100					100
Malathion	Beets				100		100
	Cabbage	100					100
	Carrots	100					100
	Celery				100		100
	Lettuce				100		100
	Melons	100					100
	Parsley				100		100
	Potatoes	100					100
	Pumpkin	100					100
	Radishes				100		100
	Squash	100					100
	Turnips				100		100
Metasystox-R	Cabbage	100					100
	Eggplant	100					100
	Peppers	100					100
	Pumpkin	100					100
	Squash	100					100
	Sweet Corn				100		100
Monitor	Cabbage	100					100
	Potatoes	100					100

Table 7-1: Pesticide Application to Vegetable Crops as Related to Pesticide Applicaor and Method of Application

Pesticide		Percent of Pesticide Applied				Method of Application	
		Self		Commercial Applicator		Band	Broadcast
Insecticide	Crop	Ground	Aerial	Ground	Aerial	(%)	(%)
Parathion	Beets				100		100
	Cabbage	2			98		100
	Lettuce				100		100
	Melons	100					100
	Onions	100					100
	Parsley				100		100
	Pumpkin	100					100
	Radishes	10			90		100
	Spinach				100		100
	Squash	100					100
	Sweet Corn	41			59		100
	Turnips				100		100
Phosdrin	Celery				100		100
	Lettuce	100					100
Sevin	Beans (Green)	100					100
	Beets				100		100
	Cabbage	100					100
	Eggplant	100					100
	Lettuce	100					100
	Melons	100					100
	Peppers	100					100
	Potatoes	63			37		100
	Pumpkin	100					100
	Squash	100					100
	Sweet Corn	28			72		100
	Turnips				100		100
Temik	Potatoes	100					100
Thiodan	Cabbage	100					100
	Lettuce	100					100
	Peppers	100					100
	Potatoes				100		100
	Spinach				100		100
	Squash	100					100

Table 7-2: Pesticide Application to Vegetable Crops as Related to Pesticide Applicator and Method of Application

PESTICIDE		Percent of Pesticide Applied				Method of Application	
		Self		Commercial Applicator		Band	Broadcast
B. Herbicide	Crop	Ground	Aerial	Ground	Aerial	(%)	(%)
Aatrex	Sweet Corn	94			6		100
Amiben	Eggplant	100					100
	Melons	100					100
	Pumpkin	100					100
	Squash	100					100
Bladex	Sweet Corn	44			56		100
CIPC	Lettuce	100					100
	Onions	100					100
	Spinach	100					100
2,4-D	Sweet Corn	100					100
Dacthal	Cabbage	100					100
	Melons	100					100
	Onions	100					100
Dinoseb	Potatoes	50			50		100
Enide	Peppers	100					100
Eptam	Potatoes	100					100
Lasso	Onions	100					100
	Potatoes	100					100
	Sweet Corn	100				20	80
Lorox	Carrots	100					100
	Potatoes	100					100

Table 7-2: Pesticide Application to Vegetable Crops as Related to Pesticide Applicator and Method of Application

Pesticide		Percent of Pesticide Applied				Method of Application	
		Self		Commercial Applicator		Band	Broadcast
B Herbicide	Crop	Ground	Aerial	Ground	Aerial	(%)	(%)
Princep	Asparagus	100				50	50
Pyramin	Beets	100					100
Randox	Onions	100					100
Sencor	Potatoes	100					100
Stoddard Solvent	Parsley	100					100
Sutan	Sweet Corn				100		100
TOK	Cabbage	100					100
	Carrots	100					100
	Celery	100					100
	Melons	100					100
	Parsley	100					100
	Sweet Corn	100					100
Treflan	Beans (Green)	100					100
	Cabbage	100					100
	Eggplant	100					100
	Melons	100					100
	Parsley	100					100
	Peppers	100					100
Vegedex	Beans (Green)	100					100
	Beets	100					100
	Celery	100					100
	Lettuce	100					100
	Onions	100					100
	Spinach	100					100
	Turnips	100					100
MH-30	Potatoes	47			53		100

Table 7-3: Pesticide Application to Vegetable Crops as Related to Pesticide Applicator and Method of Application

PESTICIDE		Percent of Pesticide Applied				Method of Application	
		Self		Commercial Applicator		Band	Broadcast
C. Fungicide	Crop	Ground	Aerial	Ground	Aerial	(%)	(%)
Benlate	Melons	100					100
	Pumpkins	100					100
	Squash	100					100
Bravo	Cabbage	100					100
	Melons	100					100
	Onions	100					100
	Potatoes	100					100
	Pumpkin	100					100
	Squash	100					100
Captan	Melons	100					100
	Onions				100		100
	Potatoes	100					100
	Pumpkin	100					100
	Squash	100					100
Copper	Cabbage				100		100
	Celery				100		100
	Melons	100					100
	Peppers	100					100
	Potatoes	100					100
	Pumpkin	100					100
	Squash	100					100

Table 7-3: Pesticide Application to Vegetable Crops as Related to Pesticide Applicator and Method of Application

Pesticide		Percent of Pesticide Applied				Method of Application	
		Self		Commercial Applicator		Band	Broadcast
C. Fungicide	Crop	Ground	Aerial	Ground	Aerial	(%)	(%)
Difolatan	Potatoes	100					100
Dyrene	Celery				100		100
	Onions	76			24		100
Mancozeb	Cabbage				100		100
	Celery				100		100
	Melons	100					100
	Onions				100		100
	Parsley				100		100
	Potatoes	61			39		100
	Squash	100					100
Maneb	Carrots	50			50		100
Zineb	Beans (Green)	100					100
	Beets				100		100
	Lettuce	100					100
	Onions	100					100
	Peppers	100					100
	Radishes	14			86		100
	Spinach	100					100
	Turnips				100		100
Ziram	Melons	100					100
	Peppers	100					100
Polyram	Potatoes	100					100

Table 8-1: Protective Gear Utilized by Vegetable Growers in Association with Pesticide Mixing, Handling and Application

PESTICIDE	Percent of User Personnel Utilizing Protective Gear									
A. Insecticide	Number of Users Reported	Face Shield or Goggles	Respirator or Gas Mask	Rubber/Plastic Apron	Water Resistant Spray Suit	Cotton Coveralls	Rubber/Neoprene Gloves	Rubber/Neoprene Boots	Washable Head Covering	Enclosed Tractor Cab
Chlordane	2								50	
Counter	1					100				
Cygon	1									
Diazinon	7	43	29	14	43	14	71	29	43	14
Dibrom	2									
Dipel	4	25	25	25	25	25	50	25	25	
Di-Syston	5	20	20		20	20	80	20	40	20
Dyfonate	3	33	33	33	33		33	33	33	
Dylox	1	100			100		100	100		
Ethion	4	50	25	25	25	25	50	25	50	
Furadan	3						33	33		
Guthion	5	20	20	20	20		60	40	40	20
Lannate	8	25	38	12	25		63	38	12	12
Malathion	4	25	25	25	50		25	25	50	
Metasystox-R	2		50				100	50		50
Monitor	3	33	33	33	33		67	33	33	33
Parathion	8	38	38	25	25	12	63	25	38	12
Phosdrin	3	67	67	33	33	33	67	33	67	
Sevin	13	23	15	8	15	23	54	15	38	8
Temik	3		33		33		33			
Thiodan	6	33	17	17	33		33	33	17	

Table 8-2: Protective Gear Utilized by Vegetable Growers in Association with Pesticide Mixing, Handling, and Application

PESTICIDE	Percent of User Personnel Utilizing Protective Gear									
B. Herbicide	Number of Users Reported	Face Shields or Goggles	Respirator or Gas Mask	Rubber/Plastic Apron	Water Resistant Spray Suit	Cotton Coveralls	Rubber/Neoprene Gloves	Rubber/Neoprene Boots	Washable Head Covering	Enclosed Tractor Cab
Aatrex	4					25	50		50	25
Amiben	4	25				25	75	25	25	
Bladex	3						33		33	33
CIPC	7	29	29	14	29		29	29	29	
2,4-D	2	50	50		50		50	50	50	
Dacthal	4			24		75	75		75	
Dinoseb	5	20	20	20	20		40	20	20	20
Enide	1						100	100		
Eptam	3						33			33
Lasso	14	21	14	7	14	21	43	21	50	
Lorox	7	43	29	14	43	14	71	43	57	
Princep	1						100			
Pyramin	1									
Paraquat	1	100	100	100	100		100	100	100	
Ramrod	1									
Randox	5	80	60	40	60	20	100	60	80	
Sencor	3	33	33		33		33	33	33	
Stoddard Solvent	3	33	33	33	33		33	33	33	
Sutan	1							100		100
TOK	8	25	25	12	25	12	50	38	38	
Treflan	6					17	67	17		17
Vegedex	8	25	12	12	25	12	38	25	25	
MH-30	2						50			50

Table 8-3: Protective Gear Utilized by Vegetable Growers in Association with Pesticide Mixing, Handling, and Application

PESTICIDE	Percent of User Personnel Utilizing Protective Gear									
C. Fungicide	Number of Users Reported	Face Shield or Goggles	Respirator or Gas Mask	Rubber/Plastic Apron	Water Resistant Spray Suit	Cotton Coveralls	Rubber/Neoprene Gloves	Rubber/Neoprene Boots	Washable Head Covering	Enclosed Tractor Cab
Benlate	2					50	100	50	50	
2Bravo	6	17	17	17	17	17	33	17	50	
Captan	1								100	
Copper	6	17	33	17	17		33	33	33	
Difolatan	1									
Dyrene	2	50	50	50	50		50	50	50	
Karathane	1		100			100	100			
Maneb	1	100	100		100		100	100	100	
Mancozeb	7	29	14	14	29	29	57	43	43	14
Methyl Bromide	1									100
Polyram	2									
Zineb	3	33					33			
Ziram	1					100	100		100	

Table 9: Procedures Used by Vegetable Growers in Pesticide Storage

Storage Procedure	Practiced by Growers*
1. Stored in a separate building.	52.4%
2. Stored in building housing other materials	61.9%
3. Same as No. 2, but separated by a barrier	33.3%
4. Kept under locked storage	38.1%
5. Storage area is fireproof	9.5%
6. Storage area has facilities for fire protection	14.3%
7. Storage area has facilities for temperature control	9.5%
8. Storage area has facilities for air movement	42.8%
9. Storage provides for separation and segregation of pesticides	19.0%
10. Storage area has isolated drainage system	9.5%
11. Storage area is accessible only to authorized personnel	33.3%
12. Pesticides are sometimes stored in other than the original container	0.0%

* The percentage total exceeds 100% because more than one procedure may apply to an individual grower's pesticide storage practices.

Table 10: Procedures Used by Vegetable Growers in Disposing of Surplus Pesticides

Procedure	Practiced by Growers*
1. Surplus pesticide stored for use in next growing season.	100.0%
2. Surplus pesticide returned to dealer	14.3%
3. Surplus pesticide utilized for some other labeled use	4.8%
4. Surplus pesticide diluted and sprayed over isolated area	4.8%
5. Surplus pesticide buried in isolated area	0.0%
6. Surplus pesticide burned or incinerated	0.0%
7. Surplus pesticide disposed of in a landfill operation	4.8%
8. Surplus pesticide disposed of by commercial waste disposal company	0.0%
9. Surplus pesticide disposed of in environmental, municipal, or public sewer system	0.0%

* The percentage total exceeds 100% because the grower may utilize more than one procedure for disposing of surplus pesticide.

Table 11: Procedures Used by Vegetable Growers in Disposing of Empty Containers

Procedure	Practiced by Growers*
1. Metal and plastic containers are decontaminated by triple rinse or similar procedure	52.4%
2. Combustible containers are burned on premises	71.4%
3. Containers are buried on premises	9.5%
4. Containers disposed of in sanitary landfill facilities	57.1%
5. Large containers are returned to the dealer or manufacturer	4.8%
6. Containers are disposed of through barrel reclaimers	4.8%
7. Containers are disposed of through commercial waste disposal companies	9.5%
8. Containers are sometimes used for other purposes on the premises or by others	9.5%
9. Containers accumulate on premises	0.0%
10. Containers are dumped at out-of-the-way places	9.5%
11. Containers are stored for future disposal	14.3%
12. Storage facilities for empty containers are similar to or the same as that for pesticide storage and are kept locked	14.3%

* The percentage total exceeds 100% because growers may utilize more than one procedure for disposing of empty containers.

Table 12: Factors Considered the Most Important by Vegetable Growers in Selection of Pesticides

Factors	Grower Response*
1. Information Source	
A. Recommendation of dealer	55.0%
B. Recommendation of neighbor	15.0%
C. Recommendation of extension agent	80.0%
D. Advertisements from companies: radio, T.V.	15.0%
E. Personal experience	75.0%
2. Economic Factors	
A. Cost per unit treated	60.0%
B. Compatibility with existing equipment	75.0%
3. Personal Hazard Factors	
Given the choice between two chemicals with equal control potential, indicate the criteria you would use to make your choice:	
A. Choice of chemical with lower toxicity	60.0%
B. Choice of chemicals requiring less personal exposure	45.0%
C. Choice of chemicals not requiring application certification	15.0%
D. Deciding factor is satisfactory pest control; toxicity of chemical is of secondary consideration	45.0%
E. Choice of chemicals with short treatment to harvest day-waiting-time	45.0%
F. Choice of chemicals with prolonged control	30.0%

* The percentage total for each section may exceed 100% because individual growers may have responded to more than one factor applicable to his operation in each section.